

Demonstration of Observation Geometry Visualization Tools;
presented by the Navigation Ancillary Information Facility, Jet
Propulsion Laboratory, California Institute of Technology

JPL's Navigation Ancillary Information Facility (NAIF) has developed an observation geometry information system named SPICE - comprised of portable data files (SPICE "kernels"), portable software (the NAIF Toolkit) and associated standards, documentation and user support. The SPICE system is used on many flight projects including portions of Voyager 2, Magellan, Galileo, Mars Observer, Clementine and Cassini. It will also be used on Russia's Mars 94/96 missions and is being considered for use on EOS and several space physics and astrophysics projects. Components of SPICE are widely used throughout the broader space science community for a variety of purposes, including the planning of planet and satellite observations by Hubble Space Telescope and other platforms.

SPICE kernel files contain much of the ancillary data needed to plan or interpret space science observations. Included in these files are spacecraft trajectory, target body ephemerides, selected target body physical and cartographic constants, instrument geometric specifications, spacecraft attitude (orientation) and a summary of commands and other mission operations events that can help with interpretation of instrument data.

Rather than provide users just these SPICE kernel files and some documentation on their contents and formats, the NAIF group also provides users a suite of software to extract data from the kernels and to calculate many of the derived parameters of interest. This software is named SPICELIB (SPICE Library), and it is the principal component of the NAIF Toolkit. SPICELIB is a collection of well documented, portable ANSI FORTRAN 77 subroutines. Some SPICELIB modules are used to read the SPICE kernel files while other modules process these data to compute items such as latitude, longitude, lighting angles and range. SPICE users integrate selected SPICELIB subroutines into their own application program to accomplish a particular task.

Implementation of a fundamental SPICE system, including kernel designs, SPICELIB subroutine library and a few utility and tutorial ("cookbook") programs is complete. The NAIF Team is now adding important new functionality, improving existing components, developing better documentation and tutorials, adding new flight projects as major customers and assisting the many current customers by providing consultation and new kernel data files. In addition, the Team has begun assembling some observation geometry visualization applications - complete programs - that should be useful to a broad set of SPICE users. Included in this demonstration are prototypes of the **Solar System Calculator** and the **Planet Mapper** programs.

The Solar System Calculator can compute an assortment of typically useful geometric computations based on fairly simple user inputs. Two versions of this program exist: one uses a simple command line interface (useful in a traditional character terminal environment) and the second uses modern GUI interface techniques. The command line version provides only text outputs while the GUI version provides text and, in some cases, graphics. The Solar System Calculator is most useful in providing a quick answer to an ad hoc question; it is not intended to be part of a data analysis production line. The program might also serve as a

cookbook program for advanced SPICE users. The Calculator can be useful for any flight project using SPICE.

Planet Mapper started life as Mars Mapper, built by JPL's Mission Design Section to support Mars Observer's science teams. The Mapper displays a solid body surface in any of a variety of projections and then overlays the spacecraft ground track and instrument footprints. It can also be used to plot any of a set of parameters. Since it was built with a modular architecture and used SPICE and other popular planetary science standards, it is not difficult to generalize the program for further applications. Planet Mapper will soon be used on the Clementine mission and could support Mars 94, Discovery series and other planetary projects.

These demonstrations are presented for two purposes. First, the programs illustrate the kinds of calculations that are easily made using SPICE kernel files and NAIF Toolkit software. (Other parties have developed similar SPICE-based visualization programs, such as the Cassini Geometry and Graphics System [CGGS] and the Magnetospheric Planning Package [MAGPAC].) Second, feedback from Workshop participants will help refine functionality and user interfaces as these programs evolve into distributable Toolkit products.